PATENT SPECIFICATION

328,004

Application Date: Jan. 11, 1929. No. 1046/29.

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Complete Accepted: April 11, 1930.

PROVISIONAL SPECIFICATION.

Improvements in or relating to Means for Damping Torsional Vibration of Crankshafts.

We, JOHN I. THORNYCROFT & COMPANY, LIMITED, of Thornycroft House, Smith Square, in the City of Westminster, a British Company, TOM THORNYCROFT, of the same address, and VALENTINE GEORGE BARFORD, of the Motor Vehicle & Engine Works, Basingstoke, in the County of Hants, both British Subjects, do hereby declare the nature of this invention to be as follows:—

This invention relates to means for damping torsional vibration of crank shafts and it has for its object to provide for this purpose damping means that can be applied in a more effective position to a crank shaft than usual and which shall act effectively both at moderate speeds and high speeds of the crank shaft.

For this purpose, according to the invention, means adapted to damp torsional vibration of a crank shaft are applied to a crank cheek or web or to two or more crank cheeks or webs of a crank shaft.

The torsional vibration damping means may advantageously comprise a floating weight, centrifugally acting means and spring means, the centrifugally acting means and spring means being each adapted to act in varying manner on the floating weight at varying speeds of the crank shaft, the spring means being more effective at moderate speeds and the centrifugally acting means being more effective at higher speeds of the crank shaft but the combined action of both means being more or less constant or balanced at all ordinary running speeds of the crank shaft on the floating weight which acts by its inertia to damp torsional vibrations set up in the crank shaft during the running thereof.

The centrifugally acting means may conveniently be constituted by pads that are carried by a crank cheek, are acted upon by spring means constituted by coiled or leaf springs and are adapted to act frictionally on the floating weight which may be constituted by a ring arranged around the crank cheek.

Damping means according to the invention can be variously constructed and be applied to crank shafts wherein the crank cheeks are prolonged at one end to form balance weights and to crank shafts wherein the crank cheeks are not so prolonged.

According to one construction, applied to a crank shaft in which the crank cheeks are prolonged at one end to form balance weights, there is secured, as by screws, to each of the opposite side edges of each of two crank cheeks carrying a crank pin, a plate provided with two outwardly extending tubular projections which extend into holes formed in a metal friction block or pad of segmental shape, the projections on the two plates serving to support the two pads in position for use. Extending around the curved opposite ends of the crank cheek and friction pads is a floating metal ring formed with an internal groove into which the friction pads are arranged to extend and which is held in position laterally, as by lugs, formed for instance by the heads of screws fixed in the opposite peripheral end portions of the crank cheek. Arranged within each tubular projection is a coil spring adapted to bear at its inner end against the side of the crank cheek to which its carrying plate is secured and at its outer end against the inner end of the corresponding hole in the friction pad and to urge the latter outward against the inner side of the floating ring.

According to another construction, applied to a crank shaft in which the crank cheeks are not prolonged at one end to form balance weights. there is fixed, as by screws, to the opposite side edges of each crank web, a fork shaped frame provided with a transverse member that is fixed to one end of the crank cheek, as by a screw, and has a projecting portion having a convex end arranged at the same radial distance from the axis of the crank shaft as the opposite curved end of the crank cheek. The opposite side members of the said frame are provided with oppositely arranged outwardly extending pins having their axes in the same plane as the axis of the crank shaft and arranged to extend into corresponding holes formed in two oppositely arranged segmental shaped metal friction blocks or pads.

[*Price* 1/-]

Each friction block or pad is also formed with two tubular recesses arranged parallel to each other and to the pin hole and in each of which is arranged a coiled spring that bears at its inner end against the corresponding side member of the frame and at its outer end against the closed end of the corresponding recess in the block or pad. Around one end of the crank cheek, the projecting end of the frame and the friction blocks or pads is arranged a floating metal ring formed with an internal groove into which the friction blocks or pads are forced by the springs. The ring is held in position laterally by studs screwed into one of the ends of the crank cheek and the projecting end of the frame and also it may be by studs fixed in extensions of the frame, the heads of the studs extending into the groove in the ring.

According to another construction, applied to a crank shaft in which the crank cheeks are not prolonged at one end to form balance weights, there is fixed, as by screws, to the opposite sides and one end of each crank cheek, a fork shaped frame similar to that used in the construction last above described and to the projecting end of which and centrally thereof is jointed by a pin extending through the said end of the frame, the central portion of a curved spring the two oppositely extending side portions of which are bent to a circular shape and the free ends of which are enlarged to form friction blocks or pads. The spring may be a laminated one. Or the curved spring portion may be made integral with the fork shape frame. Around the crank cheek and curved spring extends, in each case, a floating metal ring against the inner periphery of which the bent end portions of the spring are caused to bear owing to their tendency to move outward. The ring is placed in position by forcing the bent end portions of the spring inward. To facilitate this action, the said end portions of the springs may be formed with holes to receive spring bending means. The ring is or may be held in place laterally between the head of the screw bolt that connects the bent spring to the frame and a washer on the bolt and between the heads and washers of other screw bolts passed through extensions of the side members of the frame. The heads of the bolts may extend into an annular recess formed in one side of the ring. The opposite side of the ring, adjacent to the washers on the bolts, need not be recessed.

In each of the arrangements hereinbefore described, the friction blocks or pads are forced outward against the inner side of the floating ring by their associated springs or by the curved end portions of the blade spring and act, when the crank shaft is running, centrifugally and frictionally against the said ring the inertia of which acts through the friction blocks and springs, or spring, to damp out torsional vibration of the crank shaft.

Dated this 11th day of January, 1929.

For the Applicants,
LLOYD WISE & Co.,
10, New Court, Lincoln's Inn, London, W.C. 2,
Chartered Patent Agents.

COMPLETE SPECIFICATION.

Improvements in or relating to Means for Damping Torsional Vibration of Crankshafts.

We, JOHN I. THORNYCROFT & COMPANY, LIMITED, of Thornycroft House, Smith Square, in the City of Westminster, a British Company, TOM THORNYCROFT, of the same address, and VALENTINE GEORGE BARFORD, of the Motor Vehicle & Engine Works, Basingstoke, in the County of Hants, both British Subjects, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to means for damping torsional vibration of the crank shaft of high speed engines. Damping means of various kinds have heretofore been proposed for this purpose involving an inertia member, for instance a heavy ring, connected to the crank shaft by a coupling device embodying frictional elements.

The present invention has for its object to provide the crank shaft of a high speed engine with torsional damping means that shall act effectively both at moderate speed and at high speed of the crank shaft and which will prevent the vibrations building up to a dangerous extent when the periodicity of the vibrations happens to coincide with the periodicity of the impulses of the engine.

For this purpose, the crank shaft of a high speed engine is provided ,according

to the invention, with torsional vibration damping means comprising a floating weight, centrifugally acting means, and spring means, the centrifugally acting means being supplemented by the spring means to act on the floating weight, the centrifugally acting means being the principle effective means at high speeds of the crank shafts and the centrifugally acting means, supplemented by the spring means, being effective at low speeds of the crank shaft. The floating weight acts by its inertia, producing friction to damp torsional vibrations set up in the crank shaft during the running thereof.

The centrifugally acting means may conveniently be constituted by pads that are carried by a crank web, frame or ring fastened to a crank shaft, are acted upon by spring means constituted by coiled or leaf springs and are adapted to act frictionally on the floating weight which may be constituted by a ring arranged around and carried by the crank web, or a frame fixed thereto, or a ring fixed to the crank shaft.

Damping means according to the invention can be variously constructed and be applied in various ways to crank shafts of high speed engines.

In the accompanying illustrative drawings Fig. 1 shows partly an end view and partly a transverse section, and Fig. 2 partly in elevation and partly in vertical section, with parts removed, one construction of torsional vibration damping means applied to a crankshaft. Figs. 3 and 4 are similar views to Figs. 1 and 2 respectively, showing a modified construction of the damping means. Figs. 5 and 6 are similar views to Figs. 1 and 2 respectively showing another modified construction of the damping means. Figs. 7 and 8 are opposite end views of a crankshaft and Fig. 9 a plan partly in horizontal section, showing a further modified construction of damping means according to the invention. Fig. 10 is a horizontal section on the line X—X of Fig. 8.

According to the construction shown in Figs. 1 and 2, which is applied to a crank shaft *a* in which the crank cheeks *b* are prolonged at one end as at b^1 to form balance weights, there is secured, as by screws *c*, to each of the opposite side edges of each of two crank cheeks *b* carrying a crank pin *d*, a plate *e* provided with two outwardly extending tubular projections *f* which extend into holes formed in a friction block or pad *g* of segmental shape, the projections on the two plates serving to support the two pads in position for use. Extending around the curved opposite ends of each crank cheek *b* and friction pads *g* is a floating metal ring *h* formed with an internal groove h^1 into which the friction pads *g* are arranged to extend as shown, and which is additionally held in position laterally on the crank cheek, as by lugs formed for instance by the heads of screws *i* fixed in the opposite peripheral end portions of the crank cheek. Arranged within each tubular projection *f* is a coil spring *k* adapted to bear at its inner end against the side of the crank cheek *b* to which its carrying plate *e* is secured, and at its outer end against the inner end of the corresponding hole in the friction pad *g* and to urge the latter outward against the inner side of the floating ring *h*.

In the construction of damping means shown in Figs. 3 and 4, as applied to a crank shaft *a* in which the crank cheeks *b* are not prolonged at one end to form balance weights, there is fixed, as by screws *m*, to the opposite side edges of each crank web *b*, a fork shaped frame *n* provided with a transverse member n^1 that is fixed to one end of the crank cheek *b* as by a screw *o*, and has a projecting portion n^2 having a convex end n^3, arranged at the same radial distance from the axis of the crank shaft *a* as the opposite curved end of the crank cheek. The opposite side members of the said frame *n* are provided with oppositely arranged outwardly extending pins *r* and r^1 having their axes in the same plane as the axis of the crank shaft *a* and arranged to extend into corresponding holes g^1 formed in two oppositely arranged segmental shaped metal friction blocks or pads *g*. Each friction block or pad is also formed with two tubular recesses g^2 arranged parallel to each other and to the pin hole and in each of which is arranged a coiled spring *s* that bears at its inner end against the corresponding side member of the frame and at its outer end against the closed end of the corresponding recess in the block or pad. Around one end of the crank cheek *b*, the projecting end n^3 of the frame *n* and the friction blocks or pads *g* is arranged a floating metal ring *h* formed with an internal groove h^1 into which the friction blocks or pads *g* are forced by the springs *s*. The ring is additionally held in position laterally by studs *t* screwed into one of the ends of the crank cheek *b* and into the projecting end n^3 of the frame *n* and also, it may be, by studs *u* fixed in extensions n^4 of the frame *n*, the heads of the studs *t* and *u* extending into the groove h^1 in the ring. In this example the ring *h* is carried by the frame *n* . . . . . n^4.

According to the modified construction

shown in Figs. 5 and 6, applied to a crank shaft *a* in which the crank cheeks *b* are not prolonged at one end to form balance weights, there is fixed, as by screws *u* to the opposite sides and one end of each crank cheek *b*, a fork shaped frame *w*, similar to that used in the construction shown in Figs. 3 and 4 above described, and to the projecting end w^1 of which and centrally thereof, is connected the central portion of a curved spring *y* the two oppositely extending side portions of which are bent to a circular shape and the free ends of which are enlarged to form friction blocks or pads *g*. The spring *y* may, as in the example shown, be made integral with the frame *w*, or it may be made in two separate side portions joined at their adjacent ends to the projecting end w^1 of the frame *w* by a pin. The spring may be a laminated one. Around the crank cheek *b*, frame *w*, w^1 and curved spring *y* extends, in each case, a floating metal ring *h* against the inner periphery of which the bent end portions of the spring *y* are caused to bear owing to their tendency to move outwardly. The ring *h* is placed in position by forcing the bent end portions of the spring *y* inward. To facilitate this action, the said end portions of the springs may be formed with holes y^1 to receive bending means. The ring *h* is or may be held in place laterally between the heads x^1 of screw bolts *x* passed through parts of the frame *w*, and washers x^2 on the bolts, by nuts x^3. The heads x^1 of the bolts may extend into an annular recess h^2 (Fig. 6) formed in one side of the ring. The opposite side of the ring, adjacent to the washers, on the bolts, need not be recessed. In this example also the ring *h* is carried by the frame *w*, w^1.

In the further modified construction shown in Figs. 7 to 10 inclusive the floating inertia ring *h* is carried by the lateral peripheral flange 1^a of an annular plate or ring 1, the inner periphery portion of which is fitted tightly to an annular shoulder or spigot a^1 on the crank shaft *a* adjacent to the crank web *b*, the flange 1^a of the ring 1 surrounding but not bearing against the said crank web, so that the plate or ring 1, 1^a and floating ring *h* are carried directly by the crank shaft and not by the crank web. 4 is a pin or plug screwed through the ring 1 and adjacent crank web *b* and co-axial with the crank pin *d*, for preventing any possible rotation of the ring 1 on the shoulder or spigot a^1 of the crank shaft *a*. The pin or plug 4 may be flanged at the end 4^a to bear against a recessed part of the ring 1. Arranged between the opposite sides of the crank web *b* and the ring 1, are two recessed blocks e^1 each of which is fixed to the said ring by a cover plate 2 and bolts 3. Between the floating ring *h* and each block e^1 is a friction block or pad *g* that is confined in place between the ring 1 and corresponding cover plate 2 and is pressed against the inner surface of the floating ring *h* by a coiled spring *k* that is located within a hole in the friction block or pad *g* and bears at one end against the inner end of the hole and at the other end against the block e^1.

To enable the friction blocks or pads *g* to act against the inner periphery of the floating ring *h*, gaps are formed in the flange 1^a of the ring 1 as shown at 1^b in Fig. 8. The floating ring *h* is held in position laterally on the flange 1^a of the ring 1, on the one side by an outwardly extending flange 1^c on the ring 1, which may enter an annular recess h^1 in the floating ring *h* (Fig. 9), and on the other side by the outer edge portions 2^a of the aforesaid cover plates 2 (Fig. 8) which are arranged to overlap the said ring, as shown in Figs. 8 and 10.

In each of the arrangements hereinbefore described, the friction blocks or pads are forced outward against the inner side of the floating ring by their associated springs, or by the curved end portions of the blade spring, and act, when the crank shaft is running, centrifugally and frictionally against the said ring, the inertia of which acts through the friction blocks and spring, or springs, to damp out torsional vibration of the crank shaft.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A crank shaft provided with torsional vibration means comprising a floating weight, centrifugally acting means and spring means, the centrifugally acting means being the principal effective damping means at high speeds and the said centrifugally acting means, supplemented by the spring means, being effective at low speeds, of the crank shaft, on the floating weight which acts by its inertia, producing friction to damp torsional vibrations set up in the crank shaft during the running thereof.

2. Torsional vibration damping means according to the preceding claim, wherein the centrifugally acting means are constituted by blocks or pads that are carried and rotated by the crank shaft, are acted upon by springs and are adapted to act frictionally on a floating weight constituted by a ring arranged around and carried by the crank shaft.

3. Torsional vibration damping means

according to claim 1, wherein the centrifugally acting means are constituted by blocks or pads carried by a crank web of a crank shaft, or by a frame fixed thereto, and are forced outward by springs against the inner periphery of a floating weight constituted ring carried by the crank web, or frame, or by both.

4. Torsional vibration damping means according to claim 1, wherein the centrifugally acting means are constituted by blocks or pads carried by a ring fitted to and directly carried by the crank shaft, and the floating weight is constituted by a ring that is supported by the outer peripheral portion of the ring attached to the crank shaft and is acted upon internally by the said blocks or pads which are pressed against it by spring pressure.

5. Torsional vibration damping means according to claim 4, wherein the ring fitted to and directly carried by the crank shaft is arranged adjacent to one side of a crank web on the said crank shaft and overlaps without bearing against the said crank web, any possible rotation of the ring on the crank shaft being prevented by a pin or screw coaxial with the adjacent crank pin and extending through the crank and adjacent crank web.

6. A crank shaft provided with torsional vibration damping means constructed and arranged substantially as hereinbefore described with reference to and shown in Figs. 1 and 2; in Figs. 3 and 4; in Figs. 5 and 6; and in Figs. 7 to 10 inclusive of the accompanying drawings.

Dated this 11th day of October, 1929.

For the Applicants,
LLOYD WISE & Co.,
10, New Court, Lincoln's Inn, London, W.C. 2,
Chartered Patent Agents.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1930.

Fig.1.

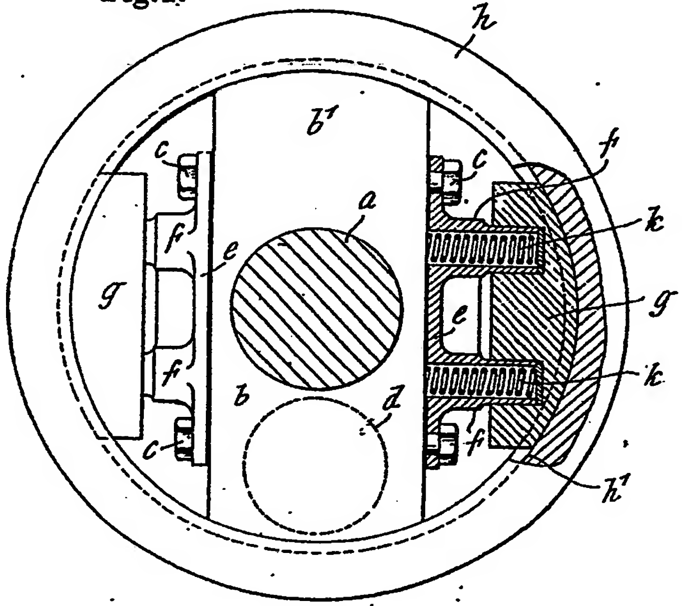

Fig.2.

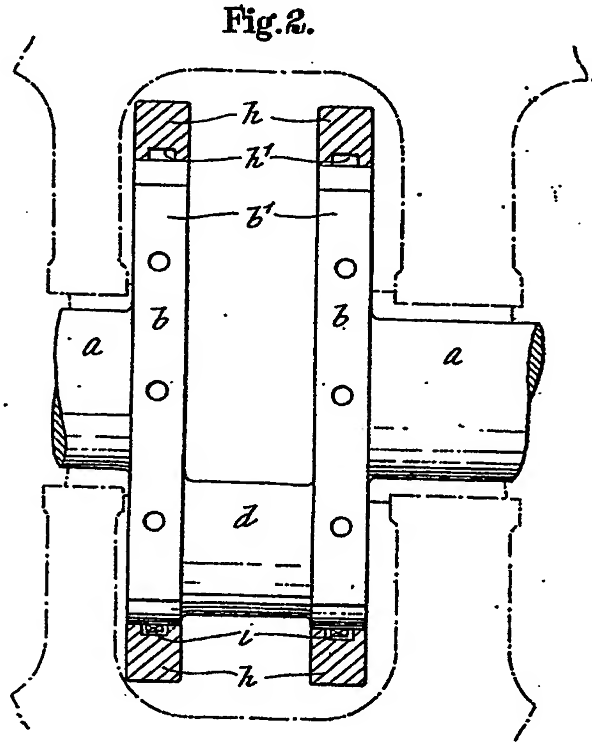

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Fig.3.

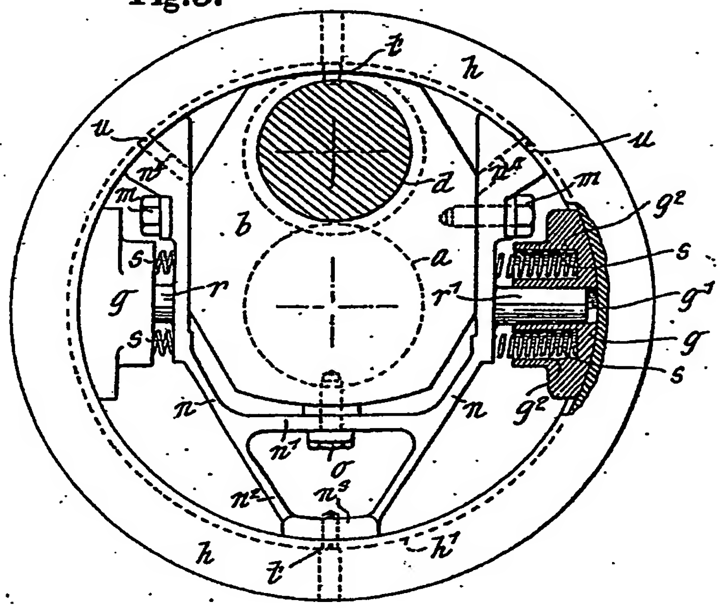

Fig.4.

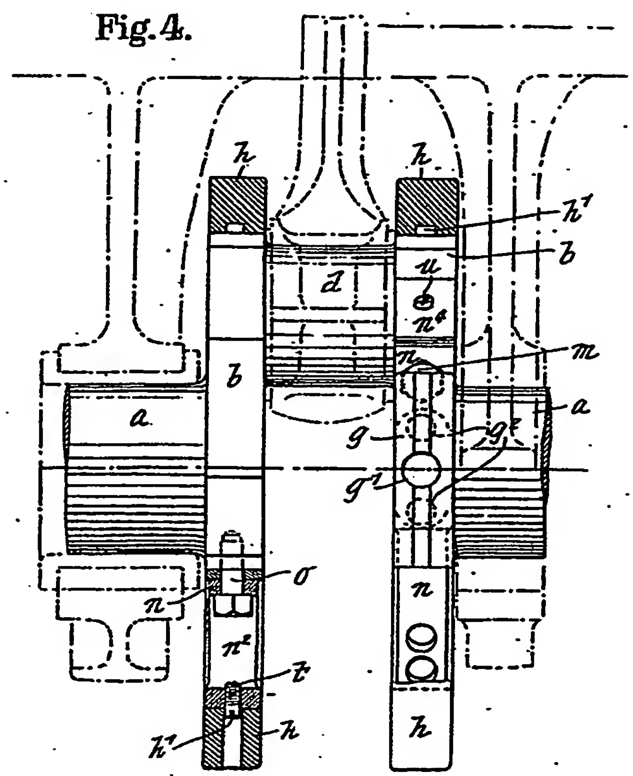

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Fig.1.

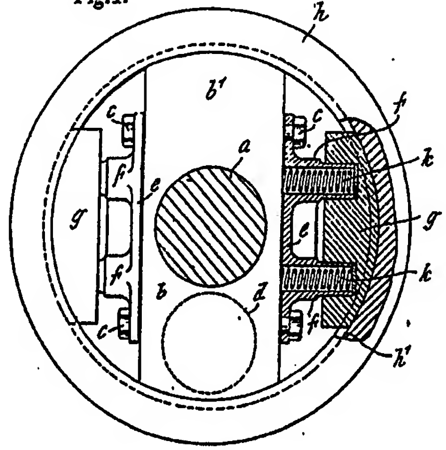

Fig.2.

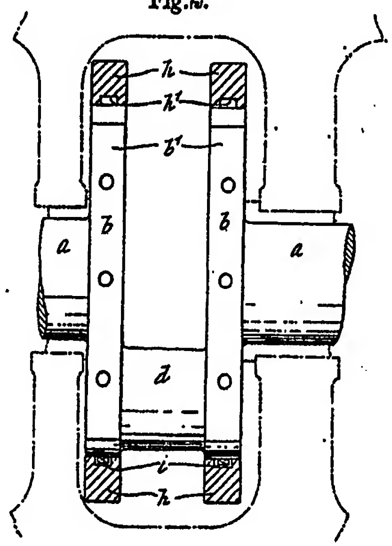

Fig.3.

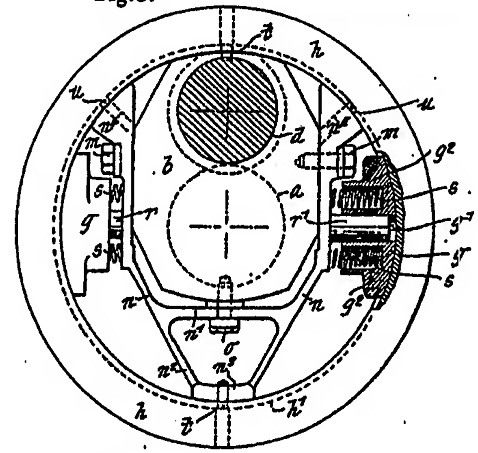

Fig.4.

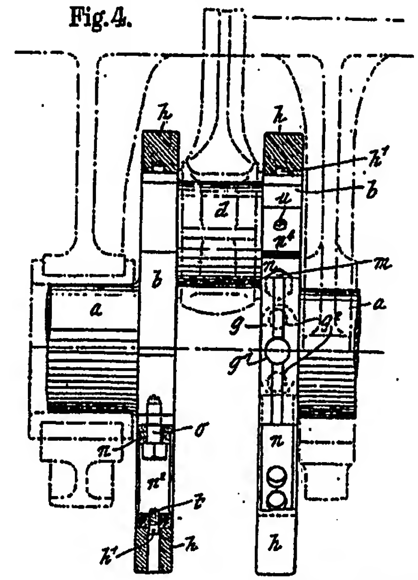

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Fig. 5.

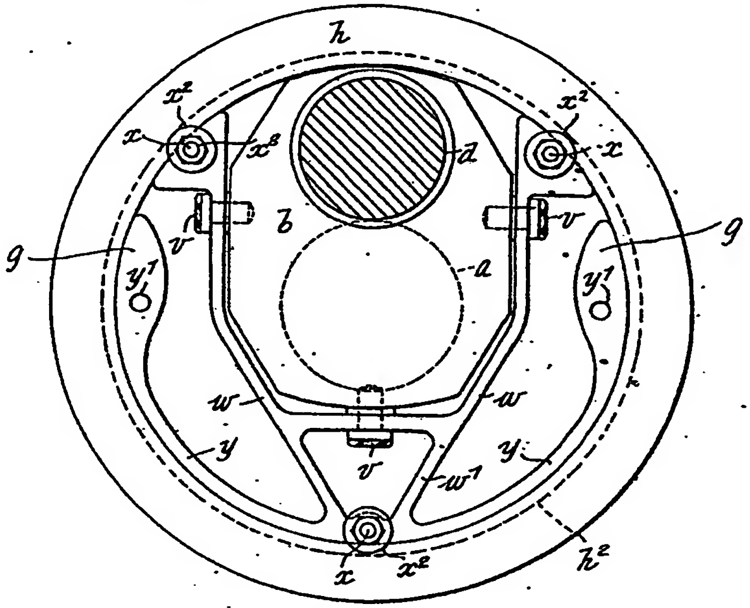

Fig. 6.

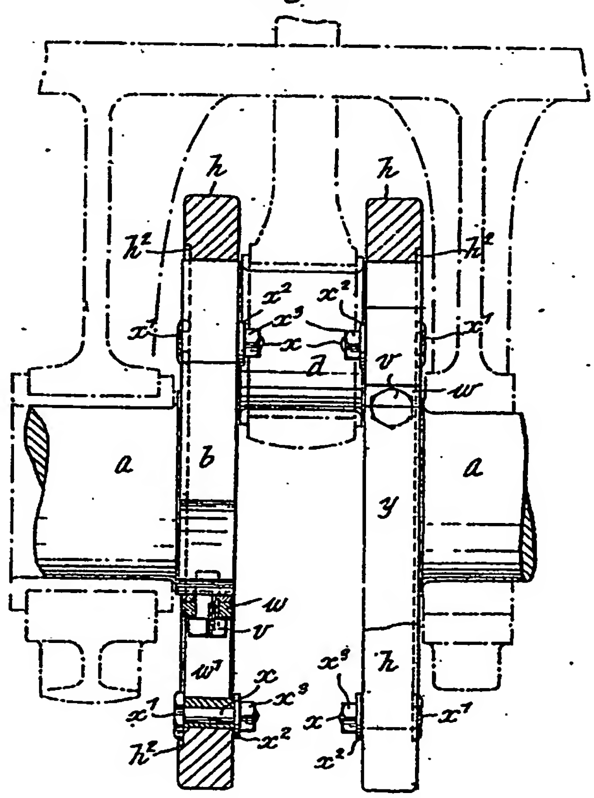

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Fig. 7.

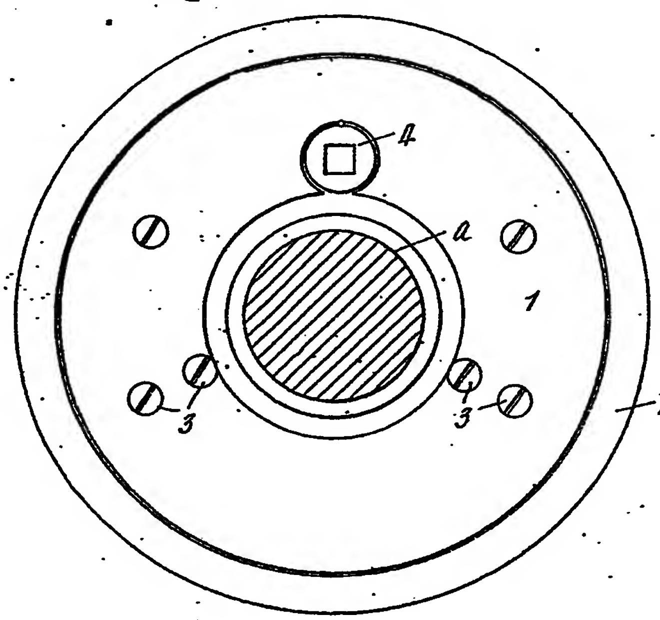

Fig. 8.

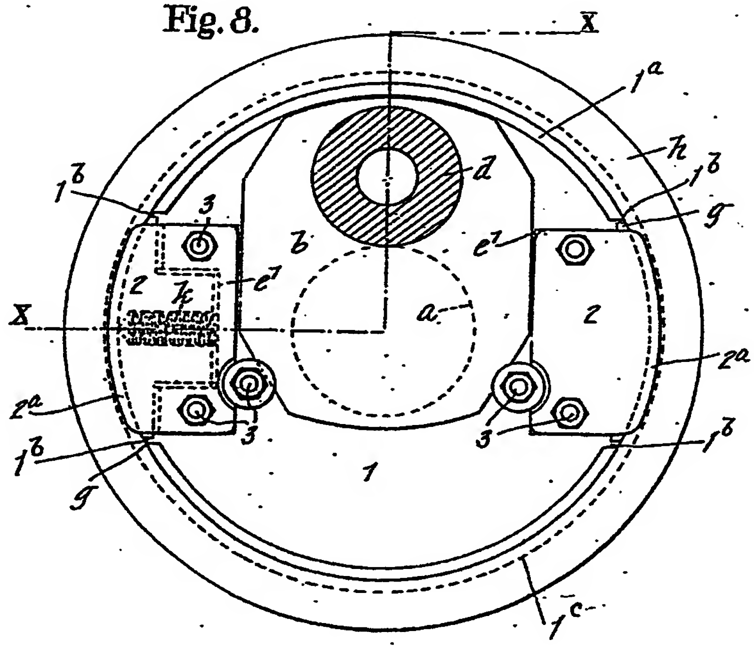

Fig. 5.

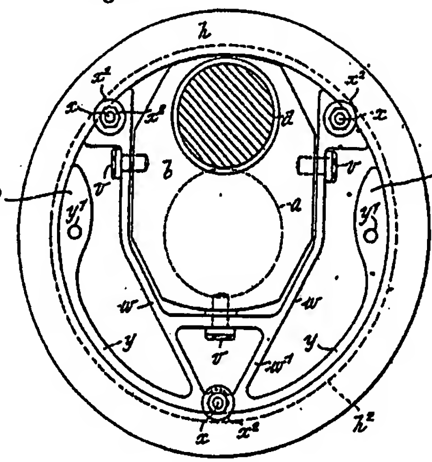

Fig. 6.

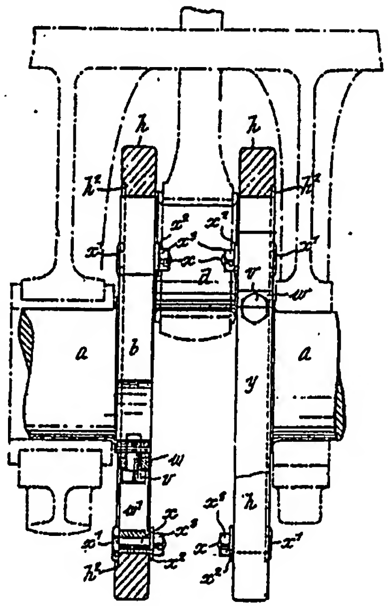

Fig. 7.

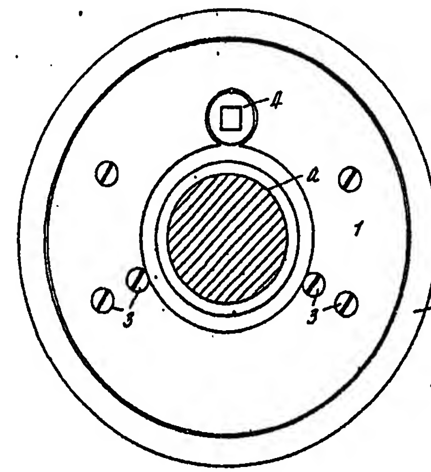

Fig. 8.

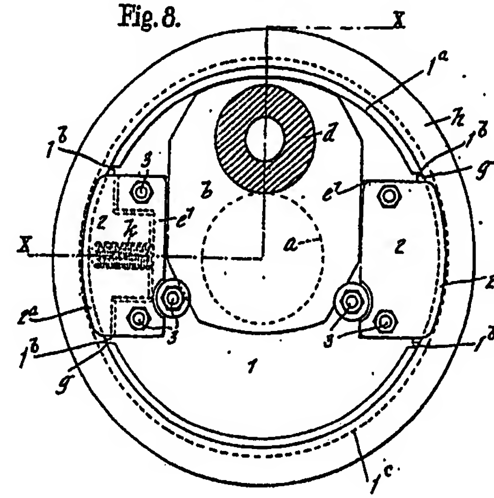

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Fig. 9.

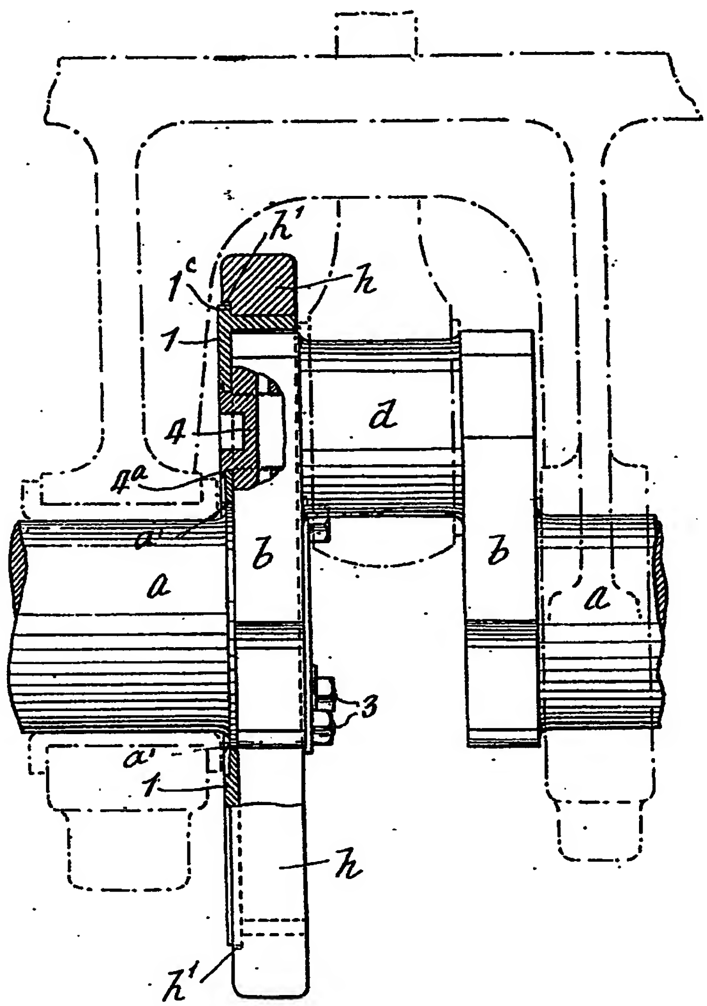
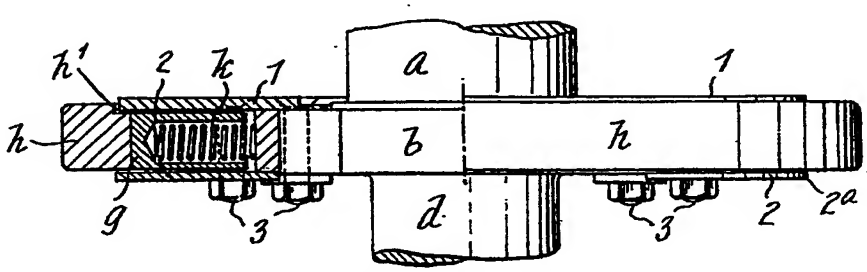


Fig. 10.



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